Portland General Electric Company

David W. Cockfield Vice President, Nuclear

March 2, 1988

Trojan Nuclear Plant
Docket 50-344
License NPF-1

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington DC 20555

Dear Sir:

Control Room Habitability - Ammonia Detectors

Reference: Nuclear Regulatory Commission (NRC) to Portland General Electric (PGE) Letter, Control Room Habitability, January 11, 1988 (TAC No. 60942)

In response to Reference 1, the information requested on the operation of the ammonia detectors at Trojan is attached.

Sincerely,

Attachments

c: Mr. John B. Martin
Regional Administrator, Region V
U.S. Nuclear Regulatory Commission

Mr. William Dixon
State of Oregon
Department of Energy

Mr. R. C. Barr
NRC Resident Inspector
Trojan Nuclear Plant

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1. Information Requested

Provide a copy of the procedures or instructions which describes the means by which detector sensitivity and response time was determined.

Response

A copy of the calibration procedure is provided in Attachment 2.

2. Information Requested

Provide the data sheets for each of the redundant ammonia detectors which document the results of the tests/observations, for the period October 1986 to December 1987.

Response

Two sets of ammonia detector calibration logs are provided in Attachments 3 and 4. Attachment 3 covers the period of 1983, which documents experience with the original ammonia detectors manufactured by Thermo Electron Corporation. Attachment 4 provides calibration experience following receipt in 1984 of different detectors manufactured by International Sensor Technology.

As can be seen from these calibration logs, the detectors consistently failed to stay in calibration. In addition, the detectors exhibited a slow response to the presence of ammonia and frequently would never attain a reading equal to the concentration of test gas used. The detectors also were slow in returning to zero once the test gas was removed, and often would not return to zero. Because the response of these detectors is on the order of minutes rather than seconds, and the operation of these detectors is inconsistent, reliance cannot be placed on these detectors for automatic protection.

No data is available from the latter portion of 1987 due to one of the ammonia sensors having failed, which was shipped to the vendor for repair, and problems with the alarm/trip circuitry in the other detector.

3. Information Requested

Provide a discussion of your conclusions regarding optimum setpoints values.

Response

Based on the operating experience with ammonia detectors at Trojan, we have concluded that the detectors are too unreliable to be declared

operational. The response time of the detectors is too slow and they will not stay in calibration. In addition, the detectors do not discriminate-out background gases at Trojan which leads to spurious alarms. These gases include low concentrations of hydrogen sulfide from pulp and paper mills in the area, exhaust gases from operation of the emergency diesel generators and diesel-driven auxiliary feedwater pump, and hydrogen which is loaded into storage containers on the Control Building roof, and periodic hydrogen venting from the main generator.

As an alternative, Portland General Electric Company (PGE) submitted a revised analysis of the hazards presented to control room operators from ammonia. In the initial review of this analysis, the Nuclear Regulatory Commission (NRC) expressed concern about the uncertainty in this analysis. While PGE concurs that there is some uncertainty in this analysis, this uncertainty is tempered by the conservative assumptions used and the fact that the time to incapacitation (3 minutes and 48 seconds) is significantly in excess of the 2-minute criteria provided in Regulatory Guide 1.78, "Assumptions for Evaluating the Habitability of a Nuclear Power Plant Control Room During a Postulated Hazardous Chemical Release". In addition, this analysis used the accepted methodologies provided in NUREG-0570, "Toxic Vapor Concentrations in the Control Room Following a Postulated Accidental Release", and NUREG/CR-1741, "Models for the Estimation of Incapacitation Times Following Exposure to Toxic Gases and Vapors". The NRC has previously accepted ammonia analyses based on these methods at other facilities, eg, Prairie Island.

In lieu of automatic detection, PGE proposes to use human detection, administrative controls, and training to provide protection from ammonia.

BLK/kal
2326P.288

IV. CALIBRATION:

CAUTION!

DO NOT OFFSET "ZERO" ADJUSTMENT BELOW ZERO OR INSTRUMENT WILL NOT OPERATE PROPERLY.

DO NOT USE NITROGEN OR ANY OTHER INERT GAS AS A SUBSTITUTE FOR AIR, TO ZERO OR CALIBRATE THE INSTRUMENT, OR TO CHECK CALIBRATION.

Some sensors show very little offset when "zero" adjustments are made. For such units, "zero" adjustments should be made by turning the control as far clockwise as possible to set zero. DO NOT TURN COUNTER-CLOCKWISE TOO FAR OR THE INSTRUMENT WILL NOT OPERATE PROPERLY, DUE TO EXCESSIVE OFFSET.

When using bottled premixed calibration gas to calibrate the unit, make sure the sample has been bubbled through water so that the sample has a relative humidity of 30 - 90%. IT IS ABSOLUTELY ESSENTIAL TO DO THIS FOR ALL CO UNITS.

Do not run an accuracy test after an overdose exposure of the sensor to gases. Overdose exposures often change the sensor characteristics temporarily. The accuracy test should not be performed for from 3 hours to 2 days after exposure, depending on the length of exposure and the chemicals the sensor has been exposed to.

To insure accuracy of the instrument, it is necessary to calibrate periodically. It is recommended that calibration be performed twice each month at the beginning, and thereafter set your own calibration procedure and frequency.

A) Calibration should be carried out in a fume hood or a well ventilated room, away from interfering gases.

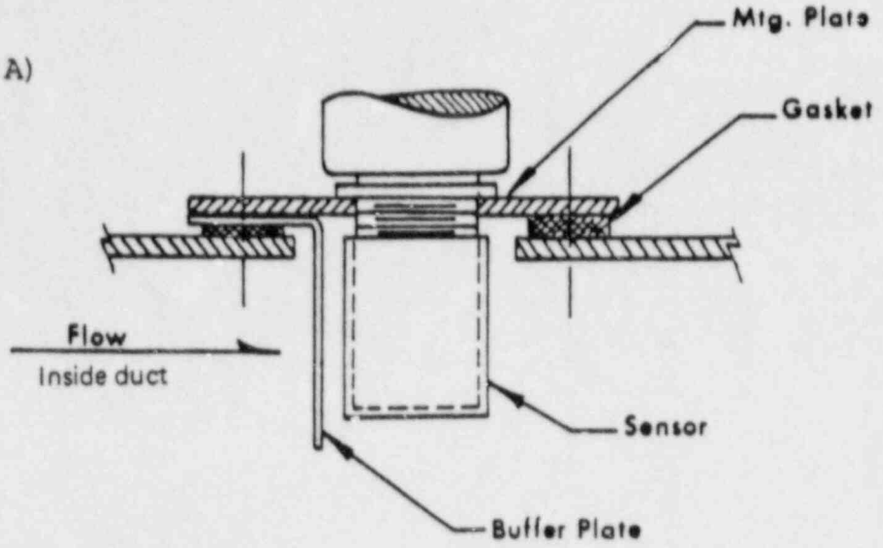
1) In an environment of clean air, free of hydrocarbons, adjust the ZERO set potentiometer until the instrument reads zero. If bottled clean air is used, moisture must be added to the sample.

2 1A) Pre-treat canister with ~500 PPM NH_3 for about one minute and then let it air out for another minute.

2) Using a 1,000 cc closed container with access hole for sensor, place the sensor in container.

3) Using a laboratory syringe, inject appropriate amount of calibration gas into the container.

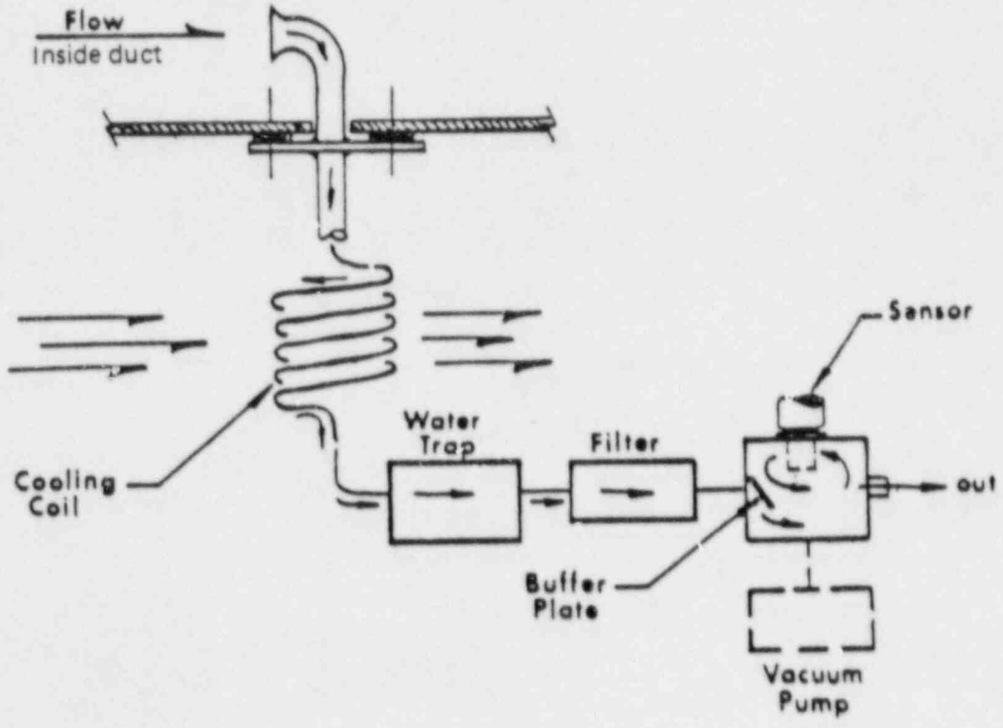
A)



Sketch "A" shows clean application, when sensor is directly inserted inside air duct.

Sketch "B" shows application involving contaminated flow. Sample is conditioned as needed before exposed to sensor.

B)



(2)

4) Allow 10 minutes for gas to diffuse in container. Turn SPAN adjustment potentiometer to make meter read correct value.

5) Remove sensor from calibration can, and allow sufficient time for instrument to stabilize in clean air.

6) Repeat steps 1 through 5, if necessary, to complete calibration.

7) For some sensors, such as H2S – Type B, the "SPAN" adjustment does not behave the same as on most other instruments. When trying to adjust the "SPAN" reading in too wide a range at one time, the meter will move up scale or down scale by itself. To make meter read proper calibration value, adjust slowly and complete the procedure in 3 - 4 adjustments, a little increment at a time.

B) For other methods, such as using a premixed sample, ampules or permeation tube, please check with GT representative for availability. Depending on the type of gas to be calibrated, premixed gas or ampules may not be available.

C) Calibration of Liquid Organic Solvents: For calibration of liquid organic solvents such as Acetone or Freon 113, it is necessary to convert the liquid into gas before calibration. In general, the following formula can be used, and it is based on ideal gas law:

W = Weight of liquid needed (g)

V_g = Gas by volume needed (cc)

D = Liquid density (g/cc)

V_1 = Volume of liquid needed (cc)

W = V_g x Gram Molecular Weight/22,400 cc

V_1 = W/D cc

As an example for Freon 113, 100 ppm calibration:

Molecular weight = 187.4

Density = 1.57 g/cc

V_g = 0.1cc for 1000cc calibration chamber

W = $0.1cc \times 187.4/22,400 = 8.36 \times 10^{-4}$ g

V_1 = 5.32×10^{-4} cc – inject this amount

If no syringe is available for a measurement this small, the following method can be used:

Take a 1000cc container with a tight lid, and inject 0.532cc of Freon 113 into the container. Rub the bottom of the container vigorously with your palm to help the Freon evaporate. This will make the gas concentration in the container equivalent to 100,000 ppm. One cc of this concentration (in the 1000cc container) will be 100ppm.

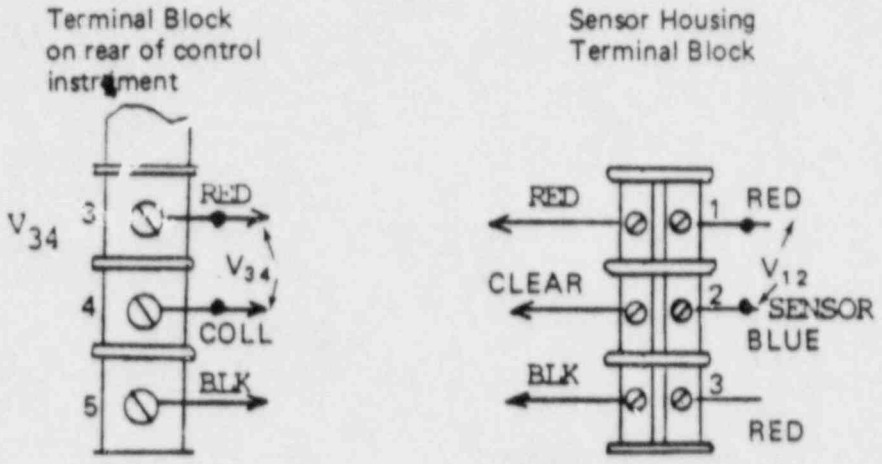
NOTE: A regular one pound coffee can or a household 36 oz. plastic container is about 1000cc. Open a hole on the plastic cover and insert sensor for calibration.

V. ONE MAN CALIBRATION PROCEDURE

Regular calibration can be a very time consuming and troublesome task, particularly when systems consist of up to a hundred points. Using this method of calibration, many valuable man-hours can be saved since one technician can accomplish the function alone.

The sensor works like a variable resistor. The voltage between the Red and Clear wires (V12 or V34) is the determining voltage which reads as ppm on the instrument meter.

The principle involves measuring the voltage, which is indicated as ppm on the instrument, and adjusting the SPAN accordingly while compensating for the voltage drop in the sensor wire.



The terminal board numbering varies slightly from model to model. V_{34} for this proceedure should be the voltage measured between the terminal marked "RED" (+) and the terminal marked "COLL" (–)

Typically, in a zero gas condition, the voltage drop between Red (1) and Clear (2) (V_{12}) is around 8 volts. While in the gas condition or during exposure to the calibration gas, the voltage is 5 to 7 volts.

The application is best accomplished using the following form:

SENSOR LOCATION #1				SENSOR LOCATION #2			
Zero Gas Voltage		50 ppm Voltage		Zero Gas Voltage		50 ppm Voltage	
Inst. V34	Sensor V12	Inst. V34	Sensor V12	Inst. V34	Sensor V12	Inst. V34	Sensor V12

2

01-011

Note that two voltage points are measured, one at the sensor and the other at the instrument in order to compensate for the voltage drop which takes place in the sensor wire.

The Procedure:

1) When the instrument is first installed, plug in and wait for two days for the sensor to stabilize.
2) Zero in by adjusting ZERO.
3) Measure zero gas voltage V34 and record on the form.
4) Go to the sensor, measure zero gas voltage V12 and record on the form.
5) Calibrate with gas and measure V12 while the sensor is exposed to gas and record on the form.
6) Calculate the voltage drop by using the following formula (using voltages measured at zero gas)

   V34 minus V12 = Δ V

7) Then compensate for the voltage difference as follows:

   V12 Gas plus Δ V = V34 gas

   Record on the form.
8) Press PRESET switch and turn PRESET Adjustment Potentiometer until V34 is made equal to V34 gas as calculated in 7 above.
9) While PRESET switch is pressed, turn "SPAN" Adjustment Potentiometer to read ppm value corresponding to calibration gas concentration.

NOTE: A high impedance voltage meter should be used (more than 100,000 ohm/volt) and the same meter should be kept for calibration purposes only.

After the first or second careful calibration, subsequent calibration operations can be accomplished by simply comparing V34 gas with the previous reading and determining if span adjustment is needed.

VI. SENSOR HEATER VOLTAGE:

There is a regulated current source which supplies the current to the sensor heater. This is a most critical adjustment, and unless it is absolutely necessary, do not attempt to adjust. The adjusting potentiometer is located on the main circuit board and it is the only one there.

One of the following procedures can be used to set the heater voltage (terminals 1 and 3, red to red):

1) Two persons with walkie talkies are required, one at the instrument module and the other at the sensor. Adjust heater voltage per following table:

Sensor Type	Sensor Heater Voltage
CO	1.35 – 1.5
H2S-A	1.25 – 1.45
H2S-B	0.6 – 0.8
CL2	1.45 – 1.80
NH3	1.2 – 1.45 ← A = 1.469 VDC (09-10-85) B = 1.399 VDC (09-10-85)
%LEL	2.2 – 2.4
VCL	1.2 – 1.35V
Ethylene Oxide	1.25 – 1.5
Hydrogen	2.0 – 2.15
Vinyl Cyanide	1.15 – 1.25V

Make sure the above voltage is measured at the sensor.

For gases not listed above, check the Serial Number Tag on "Sensor Type" or contact IST.

Specific heater voltage varies according to individual requirements.

2) Remove the sensor from the sensor housing connector and bring it to the instrument module. Connect sensor directly to module and set voltage, then re-connect to sensor housing. Voltage set will be the same.

VII. EFFECT OF SENSOR HEATER VOLTAGE UPON RESPONSE CHARACTERISTICS:

As stated above, this setting is relatively complicated, and unless it is necessary, do not touch this adjustment. Unlike regular electronic components, each gas sensor behaves like an individual, and it takes a trained person to understand their behavior. Generally the following rules can be followed to adjust the heater voltage setting.

1) In calibrating the sensor, generally try to accomplish the response time like a normal curve. This means the rise and fall response times are approximately equal. Higher voltage setting above the normal will yield slower rise time and faster return. With lower voltage, the effect will be just the opposite.

2) A higher voltage setting generally makes a low concentration range read lower. A 50 ppm unit for example, after calibrating for 50 ppm, 10 ppm might only read 6 ppm. With lower voltage, the effect will be just the opposite.

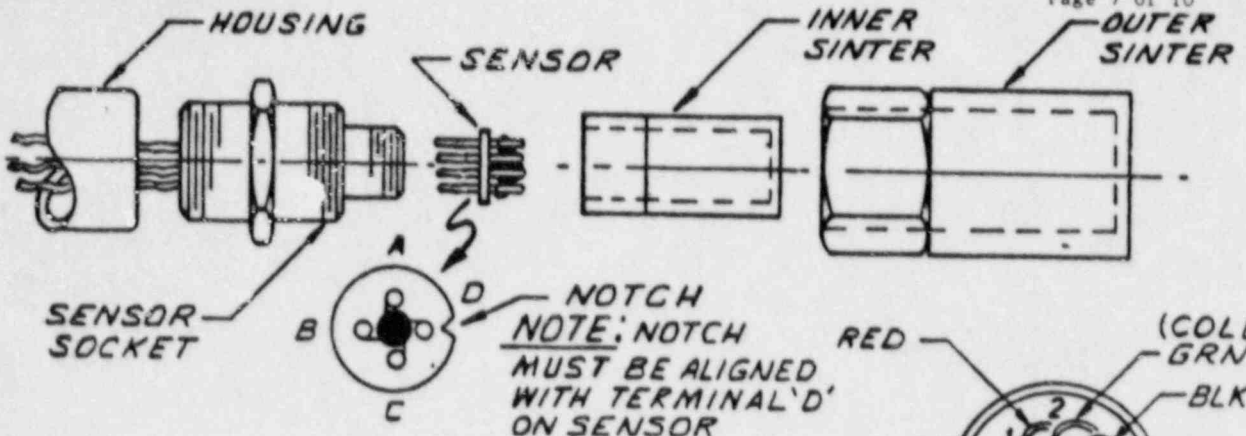
3) For detecting higher gas concentrations, use higher voltage setting, while for lower gas concentrations, use lower voltage setting.

4) With a slightly higher voltage setting, the sensor is more stable.

5) Lower heater voltage generally yields greater sensitivity than a higher one.

IMPORTANT: MAKE AN ADJUSTMENT OF NO MORE THAN ± 0.05 VOLTS AT A TIME. THE FINAL VOLTAGE SETTING SHOULD NOT BE MORE THAN ±0.1 VOLT AS SPECIFIED.

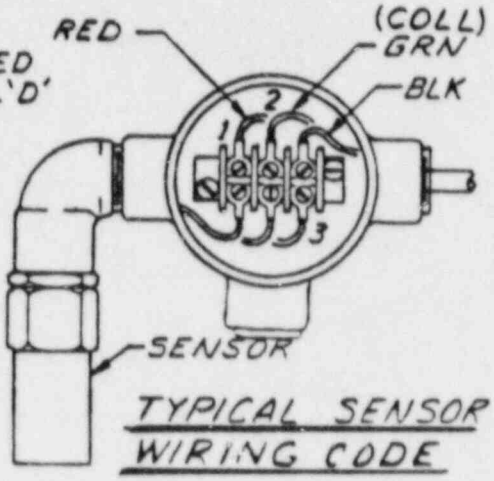
MAKE DETAILED CALIBRATION AND ALARM CHECKS TO INSURE PROPER OPERATION. WAIT AT LEAST ONE HOUR AFTER ADJUSTING HEATER.



NOTE: NOTCH MUST BE ALIGNED WITH TERMINAL 'D' ON SENSOR SOCKET.

PIN D ON SENSOR HAS RED DOT BESIDE IT.

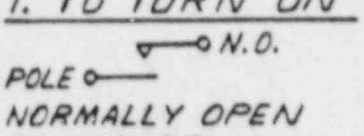
- MEASURE SENSOR HEATER VOLTAGE BETWEEN TERMINAL 1(+) & 3(−).
- MEASURE SIGNAL VOLTAGE BETWEEN TERMINALS 1 (+) & 2 (−).



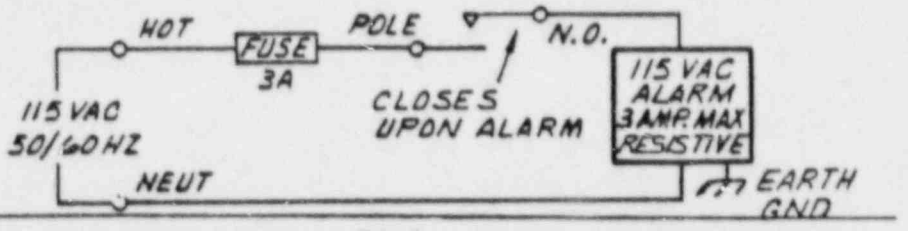
TYPICAL SENSOR WIRING CODE

TYPICAL ALARM WIRING
(RELAY CONTACTS SHOWN FOR ZERO GAS)

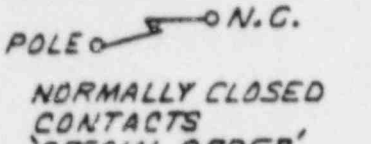
1. TO TURN 'ON'



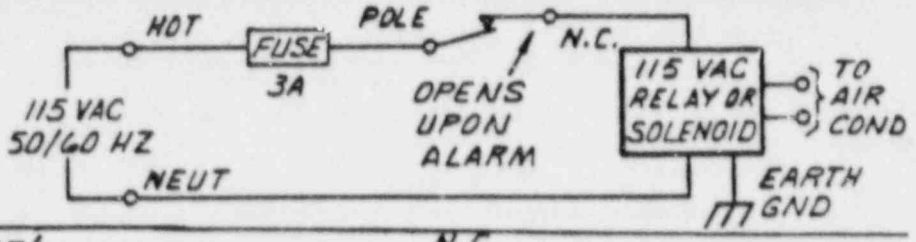
NORMALLY OPEN CONTACTS STANDARD



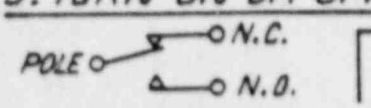
2. TO TURN 'OFF'



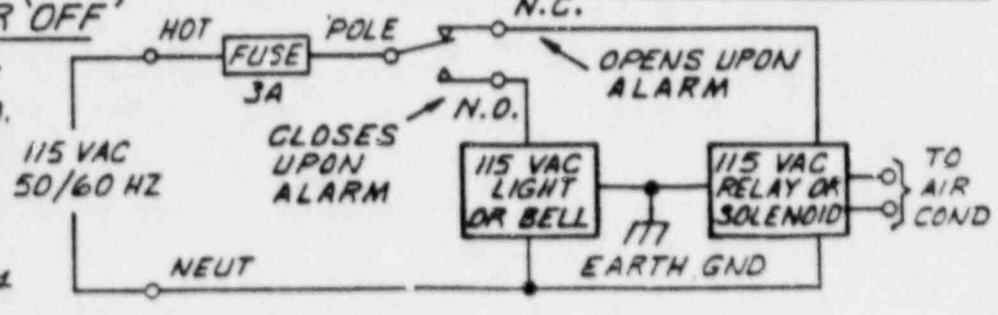
NORMALLY CLOSED CONTACTS 'SPECIAL ORDER'



3. TURN 'ON' OR 'OFF'



BOTH CONTACTS STANDARD FOR: AG3100 AG2000 & AG2002-2004



5) CONTINUED FROM PAGE 12:

AFTER ADJUSTING HEATER VOLTAGE OR STARTING CALIBRATION WITH NEW SENSOR, PERFORM THE FOLLOWING:

a. Pre-Treat Canister
b. Turn SPAN Adjust Full CCW and Adj. Zero
c. Put in 75 PPM Sample and Adjust R41 for 45% of Full Scale (30 to 35 PPM)
d. Set SPAN for Full Scale Reading
e. Meter Should Return to Zero in 10 to 15 Minutes. If not, Adjust Zero, Then Recheck SPAN at 75PPM
f. Calibrate With 25 PPM Gas. Should Read ± 7.5 PPM in Same Amount of Time it Took to Reach 75 PPM
g. Final Calibration of SPAN Pot to be Made at 25 PPM

SIGNAL VOLTAGE
(TYPICAL VOLTAGES TERMINAL 1 TO 2)

PPM	AVDC	BVDC
0	7.570	7.774
20	6.510	7.111
50	4.817	6.158
75	3.495	5.393

6) Sometimes the meter may drift upscale during low ppm calibration. This tailing effect can be corrected by carefully setting voltage slightly higher.

VIII. ZERO THE SENSOR AFTER INSTALLATION:

Checking the "ZERO" reading on the instrument is not always easy in an area where gas exists all the time. The following methods can be used:

a) A can of clean air can be collected outside the plant area and sealed to prevent any exchange of air with the environment. Immediately insert the sensor into the can and wait at least five minutes, then adjust "ZERO".

b) There are many types of gas mask filter canisters for filtering various gasses available on the market. Select a proper filter which will filter the background gas away and connect it with the calibration can and a hand vacuum pump. Pump the air through the filter to fill the calibration can with clean air and "ZERO" and "SPAN" calibrating can be easily carried out. It may be somewhat troublesome to do this, but once the set-up is done, it becomes routine, and it will ultimately save time and trouble.

IX. TROUBLE SHOOTING

A) Meter reading while no gas present:

1) Interference gases: The sensor is not 100% specific for the gas it is designated to detect. Check with the interference data printed on the IST brochure. The sources of the interference gas can be many, such as newly painted walls, floor polish or cleanser, air freshener, hair spray, chemical or solvent containers not covered tightly, etc.

2) For a CO instrument, the ambient always has some CO present. It is normal for the instrument to read between 0 - 10 ppm in a "clean" office.

3) Sensor's protective sinter dirty: If the inner or outer covers of the sensor are contaminated with grease or dirt, the sensor will read the gases emitted from these contaminants. Remove the sinters and rinse thoroughly in a clean solvent such as Acetone or Alcohol. Make certain they are totally dry and clean before replacing them.

4) Sometimes if the inner sinter is dirty the sensor may become contaminated also. Leave the sensor on power and place the sensor assembly in an oven and bake at about 130° F for 24 hours. This will vaporize most contaminants. If baking is impossible, turn power OFF and remove sensor. Rinse sensor with 3 or 4 solvent baths thoroughly. The final bath solution should be clear. Dry the sensor in a well ventilated area for at least an hour before installing again.

CAUTION:
a. DO NOT WASH CO SENSOR
b. DO NOT INSTALL SENSOR WHILE IT IS STILL WET
c. DO NOT RINSE SENSOR WHILE IT IS ON POWER
d. NEVER WASH ANY SINTERS OR ANY SENSORS WITH SOAP OR DETERGENT OF ANY KIND.

5) The vicinity of the sensor should be relatively clean. Install the sensor as far away as possible from any wall or machinery. A minimum distance of 6 inches from a wall is desirable.

B) Unable to reach full Span setting:

1) If calibration gas is used, make certain sufficient concentration of gas is in the calibration gas container.

2) Very active chemicals such as Chlorine etc. are easily lost during handling. Make certain a proper calibration chamber is used.
CAUTION: Do not use a metal calibration can for Chlorine calibration.

3) Excessive zero offset: If there is some background gas and the meter is reading it, turning the meter to zero, will offset the proper reading of the instrument.

4) Sensor loses sensitivity: This Solid State Electrolytic Sensor very seldom loses sensitivity, but it is operated at a relatively low temperature which allows some chemicals to blank the surface. Pressing, or shorting the "PURGE" switch for over 24 hours, or removing the sensor and applying about 1.8 to 1.9 volts across the sensor heater for 24 hours, generally will recover the sensitivity.

C) Meter reads off-scale, all alarms are on, and no gas present:

1) Sensor wire short-out, or sensor submerged in water, etc.

2) This is a very slight possibility, but the sensor can short out internally, which is called "break through." If the wiring checks OK but the problem persists, remove the sensor wires from the terminal block and test with an ohmmeter between the blue and either of the red wires. If low resistance is seen, replace the sensor.

D) To determine the overall proper functioning of the system:

1) Make sure all wires are properly connected and there is power to the system.

2) Depress the "PRESET" switch and turn the "PRESET" pot. If the meter moves up and down and the alarms turn on and off, the electronics can be considered to be functioning properly.

3) To check "ZERO" and "SPAN", depress "PRESET" switch and turn preset pot to read a value on the meter such as 40 ppm on a 100 ppm scale. While still depressing the "PRESET" switch, turn the zero pot to see if the needle moves, then set back to original point. Do the same procedure for the "SPAN".

4) Measure the regulated voltage at the instrument. Read this voltage, with a volt meter, between the "red" sensor lead and the 12VDC ground input. This voltage has to be between 8.5 and 9.2 volts.

5) Measure the sensor heater and signal voltages at the sensor. This will show if power is going to the sensor and if the heater voltage is correct.

If the above procedure checks out, the next step is to check the sensor.

6) Mis-calibration of the sensor is the most common problem encountered in the field. Mis-calibration may appear as high, low, slow, or erratic readings on the meter. Know and understand calibration procedures for LEL and PPM gases. Determine if one is calibrating the instruments properly. A little time taken to study proper calibration will prevent further problems.

7) Contamination of the sensor will cause high readings. Water, steam, oil and solvents can contaminate the sensor. Look for water marks on the plastic base of the sensor or discoloration of the bead of the sensor. Contaminated sensors usually have to be replaced.

8) Interfering background gas is the most difficult problem to determine. Observation of fine detail is important. Chemicals used nearby for processing or smoke stack discharge are common sources. In most cases, if the cause is known, sensors with a better interference ratio can be selected.

TECO MODEL 14B/E —— ANALYZER SERVICE LOG

2/15/83 A NH_3

Found +15 and -15 volt supplies reading approximately 5 V dc - problem was 757 chip on temperature comp card - replaced chip then found 310J amplifie· bad - replaced.

2/21/83 A and B NH_3

Found converter temperature controllers up to 800°C per advice from vendor - found connector bad on B - replaced connectors with twist locks.

2/22/83 A NH_3

Found screw stripped on heater connection on converter - retapped to larger screw.

2/23/83 B NH_3

Checked converter for foil around insulation - added more to what was there - still will not come up to 800°C.

5/18/83 A NH_3

Replaced converter - had run out of gain - new converter gain settings back to normal (course switch on medium and pot at mid-scale).

5/20/83 A NH_3

Found out of calibration, low - increased gain pot to nearly full scale with course switch on medium.

5/23/83 A NH_3

Out of calibration, low - increased gain pot to approximately midscale and course on high - reading high on zero with suppression pot full scale and with approximately 3 volts at Terminal C on temperature comp board.

5/25/83 A NH_3

Readings in calibration as found - whatever was drifting has stopped - swapped converters between A and B - still have high gain setting on A to get in calibration readings - gain pot slightly lower on B now with converter from A.

A converter not controlling at 800°C (reads approximately 760°C) but B is. A converter evidently does not have enough insulation or resistance of heater not enough.

6/22/83 TECO Service Rep Dana Shay Here

Cleaned reaction chambers on all four analyzers - A NH_3 chamber very dirty - B NH_3 chamber window covered with film, but did not have chunks of black crud like one on A - both SO_2 chambers very clean - still had A NH_3 gain on high setting with B on medium - swapped converters with no change. Swapped PM tubes and high-gain setting followed A PM tube to B analzyer - left them as they were and ordered new PM tube for B analyzer - gain settings left as follows:

A = 3.12 medium B = 4.23 high

6/23/83 Increased gain settings as follows:

A = 4.00 medium B = 5.15 high

6/24/83 Increased gain settings as follows:

A = 6.50 medium B = 6.10 high

6/30/83 Increased gain settings as follows:

A = 5.23 medium B = 8.00 high

Removed permeation tube and tried one at a time - each gave good readings from their individual curves.

7/5/83 Checked both NH_3s - with 3 ppm sample, A read 2.6, B read 2.75. Increased gain settings to:

A = 6.26 H B = 8.45 H

Called Dana.

7/6/83 Both NH_3s reading good - adjusted P1 on temperature comp card (A) for 9.55 V at C (was 4.26 V) to get meter to read zero with ozone generator off. Suppression pot still full scale - when finished, it still calibrated okay without adjusting gain. Talked to Frank Marino about calibrating analyzers with NO and dilution box - Dana Shay returned my call.

7/7/83 Picked up TECO 101 and bottle of NO (nitric oxide) at Analytical Lab.

7/8/83 Before starting calibration with NO, made check with NH_3 - increased gain setting on A to 690 H - the 3 ppm gas read 2.6 - B worked okay - gain still at 8.45 H - ran NO through analyzers in NO mode - when switched to NO_x mode, they both read slightly higher as follows:

A increased from 1.45 to 1.65 and 4.30 to 4.90 ppm
B increased from 1.45 to 1.60 and 4.30 to 4.80 ppm

Had to make sure manual valve in converter bypass line was full open - may need to put valve in series with converter to balance flows per Joe Collins. Increase in readings could also be from N_2 used as zero air. Gain settings are:

A = 498 L B = 035 H

HV settings are:

A = 1175 V B = 1348 V

7/11/83 Both NH_3 monitors showed electronics stable over weekend (reading NO) - calibrated both NH_3 analyzers with NO - final gain settings for A = 563 L and B = 693 M. Check with NH_3:

	A	B
1 ppm	0.6	1.1
3 ppm	1.2	3.0
5 ppm	2.2	4.3

Swapped converters:

	A	B
1 ppm	1.1	0.4
3 ppm	3.1	1.1
5 ppm	4.4	1.7

Electronics still stable reading NO (recorded).

7/14/83 Rejuvenated spare converter by flushing nitric acid through it in an attempt to oxidize the inside of the tubing.

MAN-HOURS TO DATE ON SYSTEM = 194.

7/22/83 Installed rejuvenated converter in B analyzer - checked calibration without adjusting gain dial.

	A Analyzer	B Analyzer
1 ppm NH_3	0.1	0.6
2 ppm NH_3	0.4	1.5
3 ppm NH_3	0.6	2.6
1.6 ppm NO	1.3	1.1
2.2 ppm NO	2.2	1.8
4.3 ppm NO	4.6	4.0
3 ppm NH_3	0.4	1.4

All readings still in spec without adjusting gain dial on NO, but not reading NH_3 on either analyzer - the only difference is the converter which appears not to be working on either monitor.

Temperature drifting around and pegged off scale high on Model 143 permeation tube calibration - tried to adjust it without much success.

7/25/83 Model 143 calibrator temperature pegged out off scale high.

TOTAL MAN-HOURS = 204.

JMC/3mc8A3

AMMONIA DETECTOR LOG

11-7-84 Initial checkout of new instruments on bench showed both responding when exposed to permeation tube in tube enclosure. The following voltages were read:

A detector heater voltage = 1.254 V dc
B detector heater voltage = 1.309 V dc
A signal voltage at <0 ppm = 7.134 V dc
A signal voltage at 75 ppm = 3.998 V dc
B signal voltage at 0 ppm = 7.633 V dc
B signal voltage at 75 ppm = 5.631 V dc

12-24-84 Finished calibration of both detectors in Panel C351 by removing sensors and hooking up with test cable. Recorded following readings on "A" detector:

Test Gas	Reading @ 5 Min	Reading @ 10 Min
50 ppm	52 ppm	52 ppm
50 ppm	full scale	- (found to be due to
50 ppm	full scale	- shutting off syringe and trapping NH_3 bottle pressure in syringe)
50 ppm	55 ppm	59 ppm

Waited longer and rezeroed (12/24/84)

Test Gas	Reading @ 5 Min	Reading @ 10 Min
50 ppm	47 ppm	47 ppm
25 ppm	19 ppm	20 ppm (adjusted span to read 23)
25 ppm	25 ppm	28 ppm
added 25 ppm more	69 ppm	71 ppm (THIS DOESN'T WORK)

Overnight - Rezeroed (12/25/84)

Test Gas	Reading @ 5 Min	Reading @ 10 Min
50 ppm	45 ppm	49 ppm (48 ppm after 15 min)
25 ppm	22 ppm	23 ppm (23 ppm after 15 min)

12-24-84 Readings from B detector:

Test Gas	Reading @ 5 Min	Reading @ 10 Min
25 ppm	12 ppm	12 ppm (adjust span to read 25)
50 ppm	62 ppm	- (adjust span to read 50)
50 ppm	69 ppm	62 ppm
25 ppm	28 ppm	29 ppm (adjust span to read 25)
50 ppm	52 ppm	56 ppm
25 ppm	22 ppm	22 ppm
50 ppm	full scale	(no explanation
50 ppm	full scale	for this shift)
25 ppm	38 ppm	(adjust span to 25)
50 ppm	53 ppm	56 ppm (adjust to read 52)
25 ppm	22 ppm	26 ppm

12-26-84 Performed Temporary Plant Test for acceptance of system.
TOTAL MAN-HOURS TO DATE = 46.0

12-26-84 Swing shift at 1720 had ventilation system shift. An operator immediately went upstairs and found both monitors reading 45 ppm. He pushed the purge/reset switch and both monitors returned to zero.

12-27-84 Checked monitors response to permeation tube, checked both voltages at sensor:

	A	B
Terminals 1 to 2	8.028 V dc	7.845 V dc
Terminals 1 to 3	1.252 V dc	1.303 V dc

1-7-85 1150: Operations called because the ventilation system tripped. Operator checked and found "A" monitor reading 18 ppm and decreasing and "B" monitor reading 8 ppm. Operator checked again at 1300 and found both monitors reading 8 ppm.

1-8-85 Ventilation system tripped again. Operator found personnel using spray contact cleaner a few feet away from where sensors are mounted in ductwork. He could smell spray in air fairly strong. "A" monitor was reading 25 ppm and increasing. "B" was reading 5 ppm and increasing. A few minutes later, "A" was at 50 ppm and "B" was reading 20 ppm. An electrician also said he had been there the previous day just before lunch using some belt dressing which also smells. At the end of the shift, the "A" monitor still would not go below 20 ppm. There was a bag of dirty rags, etc, still in the room. The operator opened the door between the sensors and the readings on both monitors increased. He closed the door and readings on both decreased.

1-9-85 Both monitors still reading 10 to 15 ppm with "A" coming up to 30 ppm twice. It was the second time it happened. It occurred at the same time the wind shifted 180° and started coming from Longview (Washington). "A" was reading 32 ppm, "B" reading 12 ppm after CB-2 (normal control room ventilation) had been tripped for about 1 hour.

1-10-85 "A" monitor still reading 12 ppm, "B" reading 2 ppm. "A" increased to 16 ppm with door open then dropped back to 12 ppm when door was closed. Wind not blowing from Longview but can still smell something around door opening similar to belt dressing.

1-11-85 "A" still reading 8 ppm, "B" reading zero. Cleaned sintered cover and reinstalled. No help. Swapped covers between "A" and "B", no difference, also noticed the filament voltage changed with cover off:

"A" with cover on = 1.249 V dc	Off = 1.225 V dc
"B" with cover on = 1.500 V dc	Off = 1.467 V dc

Talked to vendor and he suggested putting a 3-volt battery across the filament for not more than 1 minute to burn off any contaminants on sensor.

1-14-85 Put 3-volt battery across "A" filament for 1 minute. Reading dropped to just below zero and was steady one hour later. Adjusted zero potentiometer and put back into service. "A" reading 3 ppm at 1600.

TOTAL MAN-HOURS TO DATE = 66.0

1-15-85 Found "A" reading 10 ppm and "B" reading zero. Swapped sensors between monitors. "A" still reading 10 ppm and "B" reading zero. Recorded the following voltages:

	A Monitor B Detector	B Monitor A Detector
Terminals 1 to 2	8.058 V dc	8.181 V dc
Terminals 1 to 3	1.225 V dc	1.358 V dc

Swapped detectors back to normal monitors:

	A Monitor A Detector	B Monitor B Detector
Terminals 1 to 2	8.214 V dc	7.925 V dc
Terminals 1 to 3	1.248 V dc	1.308 V dc

It appears from this that the shift in the reading is coming from the amplifier, not the sensor.

1-16-85 Found "A" reading 10 ppm. Rezeroed with zero point. Both monitors read 6 ppm at 1600.

1-17-85 Found both monitors reading zero.

1-23-85 Started complete calibration on "A" monitor with the following results:

Test Gas	Zero @ ppm	Reading @ 5 Min	Reading @ 10 Min
25 ppm	0 = 8.089 V	9 ppm	10 ppm
	2	15 ppm	18 ppm
	6	20 ppm	22 ppm

Set span to read 31 ppm, as found (minus zero setting) = 16 ppm.

Would not go to zero. Reading 12 ppm. Set zero.

Test Gas	Zero @ ppm	Reading @ 5 Min	Reading @ 10 Min
25 ppm	0 = 7.875 V	18 ppm	21 ppm

Set span to 25 ppm.

Reading would not go to zero. Reading 10 ppm.

Talked to lab. Set span full counterclockwise and rezeroed.

Test Gas	Zero	
75 ppm	0 = 7.692V	Peaked in 10 min. Set span to read 75 ppm.

1-24-85 Found reading below zero. Readjusted.

Test Gas	Zero	Reading @ 5 Min	Reading @ 10 Min
25 ppm	0 = 7.908 V	8 ppm	12 ppm

Talked to lab again. Set heater volts to 1.228 V (was 1.254 V). Set span full counterclockwise, rezeroed, zero = 7.725 V. Reading peaked in 12 min. Set to read 75 ppm with span potentiometer.

Test Gas	Zero	Reading @ 5 Min	Reading @ 10 Min	Reading @ 15 Min
25 ppm	0 = 7.570 V	12 ppm	18 ppm	20 ppm

Took longer to read maximum reading.

Dropped heater voltage down to 1.210 volts, potentiometer set counterclockwise.

TOTAL MAN-HOURS TO DATE = 84.0

1-25-85 Set to zero. Put in 75 ppm. Peaked in 13 min. Set span potentiometer. Zero reading 3 ppm. Rezeroed.

Test Gas	Zero	Reading @ 5 Min	Reading @ 10 Min	Reading @ 15 Min
25 ppm	0 = 7.350 V	12 ppm	18 ppm	22 ppm

Adjusted span to read 25 ppm - actually took 20 min to peak.

Test Gas	Zero	Reading @ 5 Min	Reading @ 10 Min	Reading @ 15 Min
25 ppm	0 = 7.305 V	13 ppm	20 ppm	23 ppm

Completes calibration of "A" monitor.

1-28-85 Checked calibration of "B" monitor: zero = 8.145 V; 25 ppm test gas injected, only read 7 ppm, peaked in 7 min. Second check: zero = 8.099 V; 25 ppm test gas injected, read 9 ppm. Adjusted span to 28 ppm. Zero volts back to 8.096 V but meter still reading 13 ppm. Turned span potentiometer full counterclockwise, changed filament volts from 1.315 V to 1.269 V.

Zero = 8.000 V. Put in 75 ppm. Peaked in 11 min. Adjusted span to read 75 ppm at 6.299 V.

	Test Gas	Reading @ 5 Min	Reading @ 10 Min
0 = 2 ppm = 7.872 V	25 ppm	19 ppm	22 ppm

Changed filament volts from 1.269 V to 1.219 V. Turned span potentiometer full counterclockwise.

1-29-85 Adjusted zero, put in 75 ppm, adjusted span to read 75 ppm, detector peaked in 12 min. 75 ppm = 4.180 V. Made minor adjustment to zero.

Zero	Reading @ 5 Min	Reading @ 10 Min
0 = 7.810 V	12 ppm	18 (14 min to peak)

Adjusted span to read 27 ppm.

Zero at 3 ppm, adjusted to zero.

Zero	Test Gas	Reading @ 5 Min	Reading @ 10 Min	Reading @ 15 Min
0 = 7.707 V	25 ppm	22 ppm	32 ppm	38 ppm

Adjusted span back down to 30 ppm.

Zero	Test Gas	Reading @ 5 Min	Reading @ 10 Min
0 = 7.801 V	25 ppm	18 ppm	23 ppm (23 ppm in 12 min)
"A" = 1.207 V		7.912 V at zero	
"B" = 1.215 V		8.009 V at zero	

TOTAL MAN-HOURS TO DATE = 106.0

1-31-85 Vendor visit: looked at our calibrations, methods and talked about problems with monitors.

2-4-85 Removed "B" monitor and sensor for shipping to factory, ran calibration check first, mixed sample 3 min in chamber.

Test Gas	Zero	Reading @ 5 Min	Reading @ 10 Min
25 ppm	0 = 8.322 V	5 ppm	8 ppm (peaked in 10 min)

Shook test gas bottle before injecting needle.

Test Gas	Zero	Reading @ 5 Min	Reading @ 10 Min
25 ppm	0 = 8.280 V	12 ppm	14 ppm (peaked in 11 min)

3-29-85 Installed "B" monitor and sensor after receiving back from vendor, removed "A" monitor and gave to the warehouse for shipping to factory.

1. Initial conditions: Terminals 1-3 = 1.255 V/Terminals 1-2 = 8.650 V.

   Zero adjust has little or no response - mechanical zero high and very hard to adjust.

2. Adjusted mechanical zero, turned on power, meter reading slightly below zero at 8.584 V dc, used January 1985 ammonia bottle.

3.

Test Gas	Reading @ 2 Min	Reading @ 5 Min	
50 ppm	8 ppm	10 ppm (at 7.977 V)	10 ppm peak @ 8 min

4. Returned to 2 ppm in 4 min, response much faster.

5. Zero slightly low at 8.488 V, used December 1984 ammonia bottle.

Test Gas	Reading @ 2 Min	Reading @ 5 Min	
50 ppm	18 ppm	21 ppm	22 ppm peak @ 7 min

6. Zero slightly below zero with zero adjust full clockwise or counterclockwise.

Test Gas	Reading @ 2 Min	Reading @ 5 Min	
50 ppm	22 ppm	29 ppm	30 ppm peak @ 8 min

TOTAL MAN-HOURS TO DATE = 118.0

4-1-85

1. Found reading slightly below zero at 8.425 V, used January 1985 ammonia bottle and shook well.

Test Gas	Reading @ 2 Min	Reading @ 5 Min	
50 ppm	26 ppm	38 ppm	40 ppm peak at 8 min

2. Meter now slightly above zero - used January 1985 bottle of ammonia.

Test Gas	Reading @ 2 Min	Reading @ 3 Min	Reading @ 5 Min	
25 ppm	17 ppm	20 ppm	22 ppm	22 ppm peak @ 8 min

3. Found reading 2 ppm after 1 hour, zero adjustment now has some effect, zeroed at 8.288 V, used December 1984 bottle of ammonia.

Test Gas	Reading @ 2 Min	Reading @ 4 Min	
25 ppm	11 ppm	12 ppm	12 ppm peak @ 6 min

After an additional 5 min, still reading 8 ppm. Recovery time seems to be getting longer.

4. Talked to vendor who said the calibration canister should be pretreated with a parts per million level of roughly 10 times whatever the monitor is to be calibrated because it absorbs ammonia, possibly explaining why the readings got higher each time the gas was run in the monitor. He recommended we hold pretreatment in the canister for 1 min, then remove lid and let air out for 2 min.

Performed this procedure with January 1985 ammonia bottle, meter had returned to zero at 8.288 V dc.

Test Gas	Reading @ 2 Min	Reading @ 5 Min	
25 ppm	12 ppm	13 ppm	13 ppm peak @ 6 min

Repeated exact readings that were obtained previously without pretreating canister and using other bottle of test gas.

4-2-85 Found reading slightly below zero at 8.441 V. COULD NOT ADJUST UP TO ZERO. Used January 1985 ammonia gas bottle. Pretreated canister.

Test Gas	Reading @ 2 Min	Reading @ 5 Min	
25 ppm	8 ppm	9 ppm	9 ppm peak @ 5 min

4-8-85 Talked to vendor. He suggested pretreating canister to 500 ppm for 1 min, then letting it air-out for 30-60 seconds, then checking calibration at 75 ppm.

4-9-85 Found meter slightly above zero but was able to adjust it down. Zeroed at 8.295 V, filament at 1.256 V. Pretreated canister per 4-8-85 instructions, used January 1985 ammonia bottle.

Test Gas	Reading @ 2 Min	Reading @ 8 Min	
75 ppm	42 ppm	75 ppm	78 ppm peak @ 11 min

Reading back down to 40 ppm after an additional 4 min.

Reading back down to 20 ppm after 20 min.

Still reading 18 ppm after 30 min. Pushed reset button, waited 1 hour and found reading at 3 ppm at 8.141 V dc. Adjusted, used December 1984 ammonia bottle.

Test Gas	Reading @ 2 Min	Reading @ 3 Min	Reading @ 4 Min
75 ppm	58 ppm	75 ppm	Offscale Hi

Reading back down to 38 ppm after 4 min. Still reading 22 ppm after 1 hour. Pushed reset.

TOTAL MAN-HOURS TO DATE = 132

1987 LOG

1-12-87 Requested to resurrect Train "A" monitor. Equipment had not been touched since 2-14-86.

Found sensor voltage at 8.168 V dc.
Found filament voltage at 1.670 V dc.
Meter reading on zero.
Set alarm to 50 ppm.
Put in 100 ppm sample.
Meter peaked at 48 ppm in 26 min, alarm never received.
Meter still reading 12 ppm 1-1/2 hours later.

1-13-87 Sensor = 8.263 V dc Filament = 1.667 V dc
Put in 100 ppm Alarm set at 50 ppm

Meter read 10 ppm in 2 min.
Meter read 20 ppm in 3-1/2 min.
Meter read 30 ppm in 5 min.
Meter read 40 ppm in 7-1/2 min (5.509 V).
Meter read 50 ppm in 16-1/2 min and alarmed (4.774 V).
Removed sample.
Meter read 42 ppm in 22-1/2 min, alarm reset.
Meter read 18 ppm in 1 hour.
Meter read 8 ppm in 4 hours.

1-15-87 Sensor = 8.467 V dc Filament = 1.667 V dc
Put in 200 ppm Alarm set at 50 ppm

Meter read 10 ppm in 1 min.
Meter read 23 ppm in 2 min.
Meter read 40 ppm in 3-1/2 min.
Meter read 50 ppm in 5-1/2 min and alarmed. Removed sample.
Meter read 42 ppm in 11 min, alarm reset.

1-16-87 Sensor = 8.272 V dc Filament = 1.668 V dc
Meter reading 3 ppm, rezeroed
Put in 200 ppm

Meter read 8 ppm in 1 min.
Meter read 23 ppm in 2 min.
Meter read 36 ppm in 3 min.
Meter read 44 ppm in 4 min.
Meter read 48 ppm in 5 min.
Meter read 50 ppm in 5-1/2 min and alarmed. Removed sample.
Meter read 42 ppm in 11-1/2 min - alarm reset.
Meter read 12 ppm in 1-1/2 hours.

1-19-87 Sensor = 8.303 V dc Filament = 1.670 V dc
Meter reading on zero Put in 200 ppm

Meter read 8 ppm in 1 min.
Meter read 20 ppm in 2 min.
Meter read 33 ppm in 3 min.
Meter read 42 ppm in 4 min.
Meter read 47 ppm in 5 min.
Meter read 50 ppm in 5-3/4 min and alarmed. Removed sample.
Meter read 42 ppm in 12 min, alarm reset.
Meter read 10 ppm in 3 hours.

1-30-87 Sensor = 8.356 V dc Filament = 1.669 V dc
Meter reading on zero Put in 200 ppm

Meter read 5 ppm in 1 min.
Meter read 18 ppm in 2 min.
Meter read 30 ppm in 3 min.
Meter read 40 ppm in 4 min.
Meter read 46 ppm in 5 min.
Meter read 50 ppm in 6 min and alarmed. Removed sample.
Meter read 42 ppm in 11-1/2 min, alarm reset.
Meter read 18 ppm in 1 hour.

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